A Method of Constructing Charts by which in a few moments the Great Circle Course between any Two Points on the Globe may be accurately Obtained. By Richard A. Proctor, B.A.

It seems to me almost certain that the plan I am about to describe must have been thought of often before because it is so obvious. But as I have never seen any reference to it in works or papers where such reference was to have been looked for, I venture to bring it before the notice of the Society as having apparently a useful bearing on the problem of great circle-sailing.

It is well known that by Mr. Towson's tables the great circle course from one place to another may be calculated with considerable ease; but a construction by which such a course might be laid down on a chart is, as far as I know, still wanting. I remember having seen a paper (I believe by the Astronomer Royal) in which the difficult problem of laying down great circle courses on Mercator's charts was attacked. Later a short note appeared in which Sir John Lubbock showed how a construction founded on the principles of the gnomonic projection might be applied to the problem. I cannot at present recall where I read those papers, but I have an impression it was in the *Monthly Notices* or else in the *Memoirs* of this Society.

The fact that in the gnomonic projection the great circle course between two points is obtained by simply drawing a line through those points, is inviting. But as one cannot include in a chart even a complete hemisphere on the gnomonic projection, there is an obvious difficulty, which, as far as the purposes in question are concerned, renders the projection almost useless. And, in passing, I may note that so far as I am aware, no one has hitherto pointed out how the course between two points, one in the northern and one in the southern hemisphere, can be deduced (in great part) from gnomonic projections of the greater part of these hemispheres. The solution of the problem is exceedingly simple:—In the Northern map one must draw a straight line through the Northern station and *the antipodes* of the Southern; and the like with the Southern map. These two lines are the projection of the great circle through the points, so far as it falls within the maps. There can be no difficulty in selecting the segments which belong to the great circle course between the points.

The plan I have now to deal with has reference to the stereographic projection. In this projection every circle on the sphere appears as a circle. Every great circle is distinguished by the property that its points of intersection with the great circle around the centre of projection lie on a diameter of that circle. This in effect gives the geometrical construction for laying down a great circle through any two points on the projection. But

practically the way in this can be done on a chart is much simpler.

Every great circle through a place passes through the antipodes of that place. Now, suppose we have a stereographic projection of all the sphere except the south polar region; the north pole being the centre of projection, and we wish to find the great circle course between any two stations:—We find these two stations on the map, and we find the antipodes of *one* station; then a circle carried through these three points is the great circle required.

It would not be necessary to make any construction for determining the centre of the circle through the points. A few moments' trial with a rod-compass would give the circle quite as exactly as the usual construction. I may remark, however, that a useful addition might be made to mathematical instruments, in the form of a ruler by which a cross-line bisecting any given line at right angles might be drawn without any construction. Many forms will suggest themselves. One of the simplest and most convenient is founded on the property that the diagonals of a rhombus bisect each other at right angles. Very likely such instruments are made.

In such a projection as I have spoken of, there would be no occasion to include any regions south of the 50th or 55th parallel of south latitude. Nor need lands and seas be marked in unless it were convenient. If only the meridians (radial lines) and latitude lines (concentric circles) were marked in to every 5th degree (or to every degree, if need were) the deduced great circle course could be transferred in a few seconds to the Mercator's chart, supposed to be similarly divided.

Comet II., 1869.

(Tempel's, see p. 27.) The following elements calculated by M. Leveau from observations at Leipzig, 23 October, and Vienna, 13 and 31 October, are given *Astron. Nach.* No. 1783.

$$T = 1869,\ \text{Oct. } 9,\ 55102,\ \text{Paris M.T.}$$

$$\left.\begin{aligned} \pi &= 139^\circ\ 20'\ 43''\cdot6 \\ \Omega &= 311\ \ 27\ \ 52\cdot0 \\ \iota &= 111\ \ 32\ \ 54\cdot0 \end{aligned}\right\}$$

$$\log q = 0\cdot090056$$

The mean observation is represented as follows,—

$$O-C;\ \Delta\lambda = +0''\cdot5,\ \Delta\beta = +1''\cdot6.$$